Shell Exploration & Production Company

October 12, 2010

Mr. Mike Lidgard
U.S. EPA, Region 10
Office of Water & Watersheds, NPDES Permits Unit
1200 Sixth Avenue, Suite 900, M/S OWW-130
Seattle, WA 98101

Shell
3601 C Street, Suite 1000
Anchorage, AK 99503

Tel. (907) 646-7112
Email susan.childs@shell.com
Internet http://www.shell.com/

Dear Mr. Lidgard:

Subject: Notice of Intent under General Permit AKG-28-0000
Drillship M/V *Discoverer*
Lease Number OCS-Y-1805, Lease Block 6658

By this Notice of Intent (NOI), Shell Offshore Inc. hereby provides its required formal notice of intent to discharge under NPDES General Permit AKG-28-0000 while conducting an OCS exploration drilling program in the Beaufort Sea, Alaska. Permitted discharges will be as described in the attached materials and at the locations specified therein.

If you have questions about any component of the proposed project, please contact me at (907) 646-7112 or email susan.childs@shell.com, or call Nicole St. Amand at (907) 646-7152 or email nicole.stamand@shell.com.

Sincerely,

Susan Childs
Alaska Venture Support Integrator Manager

Attachments - Notice of Intent (NOI) Information Sheet
Location Map
Projected Generated Wastes and Discharge Methods Table
Discharge Flow Diagrams
Drilling Fluids Plan

cc: *Diane Soderlund, USEPA Region 10, Alaska Operations*
Hahn Shaw, USEPA Region 10
Jeff Walker, BOEMRE Alaska
Don Perrin, Alaska DNR
Administrative Record

ATTACHMENT 1

NOTICE OF INTENT (NOI) INFORMATION SHEET
NPDES GENERAL PERMIT AKG280000
OIL AND GAS EXPLORATION FACILITIES
ON THE OUTER CONTINENTAL SHELF AND CONTIGUOUS STATE WATERS

APPLICANT (*Owner/Operator)*					
Owner Name:	Shell Offshore Inc.		Operator Mailing Address:	3601 C Street	
Telephone Number:	907-770-3700			Suite 1000	
Operator Name:	Shell Offshore Inc.			Anchorage, AK 99503	
Telephone Number:	907-770-3700				
FACILITY					
Facility Name:	Discoverer		Facility Mailing Address:	3601 C Street	
Contact Name:	Susan Childs			Suite 1000	
Telephone Number:	907-770-3700			Anchorage, AK 99503	
Beginning Date of Operation:	July 10, 2011		Stationary Facilities	Latitude:	
Expected Duration of Operation:	approximately 34 days per well site			Longitude:	
Facility Type *(check applicable type)*	☐	Jackup	Mobile Facilities	Initial Latitude:	70° 23' 29.5814"
	☒	Drill Ship			
	☐	Semisubmersible			
	☐	Other (specify):		Initial Longitude:	145° 58' 52.5284"
Submit a site map showing the exact location of facility and discharges associated with the project. Mobile facilities may designate an area where they may be operating and must include a map showing those areas and a description of operations within those areas. If the discharge is within 4000 meters of an environmentally sensitive area indicated by the permit, those areas and their distance from the operation/discharge must be shown on the map.					
RECEIVING WATER					
☐	Chukchi Sea		☐	Other (*specify*): ☐	
☒	Beaufort Sea				
Supply confirmation with the U.S. Department of State and NOAA that the discharge is seaward of the inner boundary baseline, if applicable.					
LOCATION OF DISCHARGE					
MMS	Lease Number	**OCS-Y-1805**	ADNR	Lease Number	**N/A**
	Block Number	**6658**		Block Number	**N/A**
Range of water depths below mean lower low water (MLLW) in the lease block:		From: **107'**		To:	**107'**

Attachment 1: NOI Information Sheet **Permit No.: AKG280000**

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OIL AND GAS EXPLORATION FACILITIES
ON THE OUTER CONTINENTAL SHELF AND CONTIGUOUS STATE WATERS

Discharges (*check all that apply)*			
☐	001 Drilling Mud and Cuttings	Water Depth:	
☒	002 Deck Drainage	Water Depth:	**19.6'**
☐	003 Sanitary Waste	Water Depth:	
☐	004 Domestic Waste	Water Depth:	
☒	005 Desalination Unit Waste	Water Depth:	**19.6'**
☒	006 Blowout Preventer Fluid	Water Depth:	**discharged at seafloor 107'**
☐	007 Boiler Blowdown	Water Depth:	
☐	008 Fire Control System Test Water	Water Depth:	
☒	009 Non-Contact Cooling Water	Water Depth:	**on the surface at several locations**
☐	010 Uncontaminated Ballast Water	Water Depth:	
☐	011 Bilge Water	Water Depth:	
☒	012 Excess Cement Slurry	Water Depth:	**19.6'**
☒	013 Mud, Cuttings, Cement and Seafloor	Water Depth:	**MLC through 20" casing cuttings discharged at 97'; cement discharged at the seafloor at 107'**
☐	014 Test Fluid	Water Depth:	

Provide a brief description of the treatment process(es) and disposal practices (e.g., backhauled, reinjected, discharged, etc.) at the facility. See attached Table 1

Provide a line drawing that shows flow of discharged waste streams through the facility. Indicate intake sources, operations contributing to the effluent, and treatment units labeled to correspond to the discharges (001 – 014). Construct a flow balance on the line drawing by showing average flows between intakes, operations, treatment units, and outfalls. If a flow balance cannot be determined, provide a pictorial description of the nature and amount of any sources, and any collection or treatment measures.

Well Information			
Well Name:	**Sivulliq**	Latitude:	**70° 23' 29.5814"**
Well Number:	**N**	Longitude:	**145° 58' 52.5284"**
Beginning Drill Date:	**July 10, 2011**	Hole Diameter or Estimated Total Discharge Volume:	**36" diameter at surface, reducing through 4 stages to 8.5" at depth**

Drilling Fluid					
	☒	Water-based		☐	Lignosulfonate

Category (*check all that apply*)	☐	Oil-based	Group (*check all that apply*)	☐	Lime
	☐	Synthetic-based		☐	Gyp
	☐	Other (*specify*):		☒	Sea-water
				☒	Saltwater
				☐	Saturated Saltwater
				☒	Nondispersed (Viscosifier/Polymer) PH/PA

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Zone of Deposit Request (*applicable to those discharges within state of Alaska waters)*				
Are you requesting a Zone of Deposit from ADEC?	☐	Yes (*continue filling out this section*)	☒	No (*skip this section and proceed to Special Conditions, below*)

THE FOLLOWING INFORMATION MUST BE PROVIDED IF REQUESTING A ZONE OF DEPOSIT. The burden of proof for justifying a zone of deposit through demonstrating compliance with the requirements of 18 AAC 70.210 rests with the applicant.

Distance from shoreline of discharge point (measured at M.L.L.W.):		Average Mud density:	
Depth of discharge (measured at M.L.L.W.):		Flow Rate:	
Orientation of outfall to shoreline (e.g., perpendicular, 45°, parallel):		Total Volume:	
Orientation of outfall to water surface (e.g., perpendicular, 45°, parallel):		Maximum current and direction:	

If possible, provide salinity and temperature data from the receiving water surface to the depth of the discharge port or diffuser.

Mixing Zone Request (*applicable to those discharges within state of Alaska waters)*				
Are you requesting a mixing zone from ADEC?	☐	Yes (*continue filling out this section*)	☒	No (*skip this section and proceed to Special Conditions, below*)

THE FOLLOWING INFORMATION MUST BE PROVIDED IF REQUESTING A MIXING ZONE. The burden of proof for justifying a mixing zone through demonstrating compliance with the requirements of 18 AAC 70.240 through 18 AAC 70.270 rests with the applicant.

Distance from shoreline of discharge point or first port of diffuser (measured at M.L.L.W.):		Length of diffuser:	
Depth of discharge port or diffuser (measured at M.L.L.W.):		Diameter of port(s):	
Orientation of diffuser to shoreline (e.g., perpendicular, 45°, parallel):		Number of ports:	
Maximum current:		Port spacing:	

USE OF RECEIVING WATER AT DISTANCE FROM DIFFUSER i.e., Supply for drinking water, Supply for agriculture including irrigation & stock water, Supply for aquaculture, Supply for industrial use, Contact recreation, Secondary recreation, Fish spawning, Harvesting and consumption of raw fish, or other aquatic life (Not needed if not requesting a mixing zone from ADEC):

If possible, provide salinity and temperature data from the receiving water surface to the depth of the discharge port or diffuser.

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Special Conditions (*provide justification for all that are not required, completed or provided)*					
Special Monitoring	☐	Required	☒	Not Required	Justification:
Exploration Plans	☒	Attached	☐	Not Provided	Justification: Submitted to BOEMRE and copy attached
Biological Surveys	☐	Attached	☒	Not Provided	Justification: None Required
Environmental Report(s)	☐	Attached	☒	Not Provided	Justification: Submitted to BOEMRE as part of the Exploration Plan
Drilling Fluid Plan	☒	Complete	☐	Not Complete	Justification: Submitted with NOI.

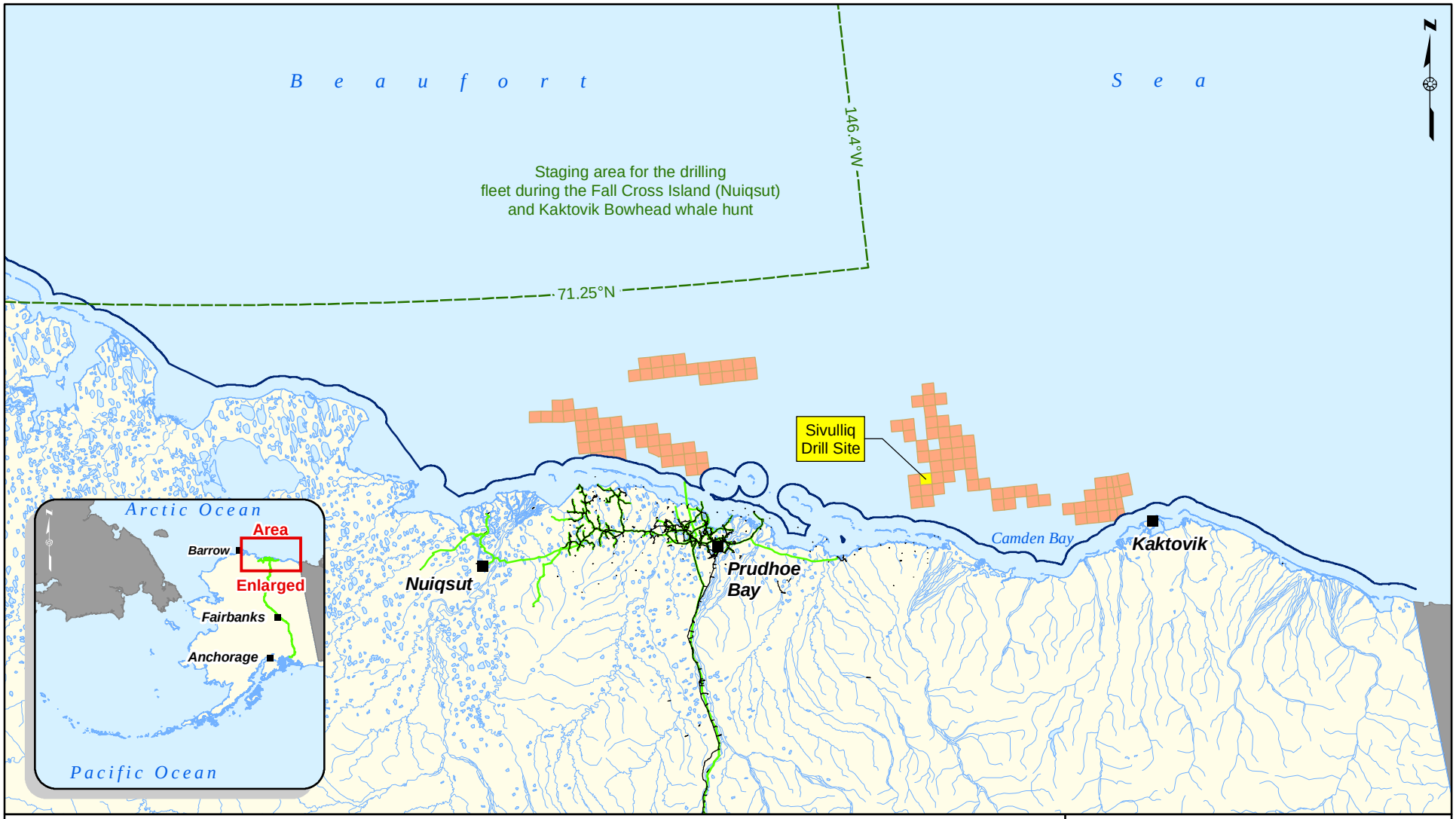
Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature:	Susan Childs	Date:	10/12/2010
Printed Name:	Susan Childs	Title:	Alaska Venture Support Integrator Manager

Mail Completed NOI to EPA and ADEC at the following addresses:

US EPA 1200 6th Avenue, M/S OWW-130 Seattle, WA 98101	ADEC, Water Division 555 Cordova Street Anchorage, Alaska 99501



Exploration Plan OCS Block
Shell OCS Lease Block
Road
Pipeline
State-Federal Water Boundary
Village

SHELL

PLANNED EXPLORATION DRILLING PROGRAM

Camden Bay Exploration Drilling Program

ASRC Energy Services
a subsidiary of Arctic Slope Regional Corporation
Regulatory and Technical Services

SCALE:
0 15 30 60 Miles

FIGURE:
1-1

NAD83, Alaska Albers Equal Area

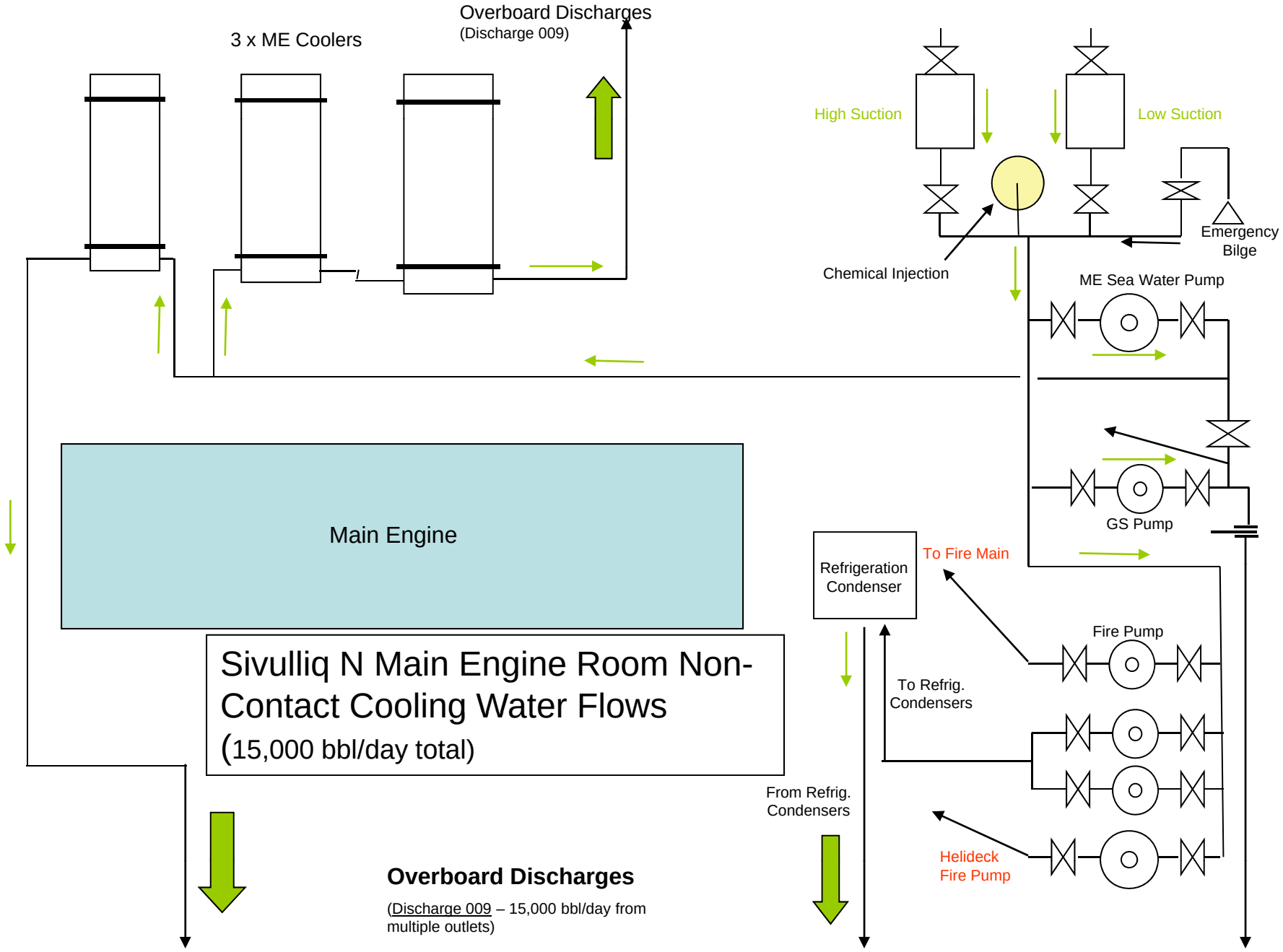
AES-RTS: Shell_SR100110_SE.mxd, 10/01/10, R00

Projected generated wastes and discharge methods – Sivulliq Prospect Drill Site N

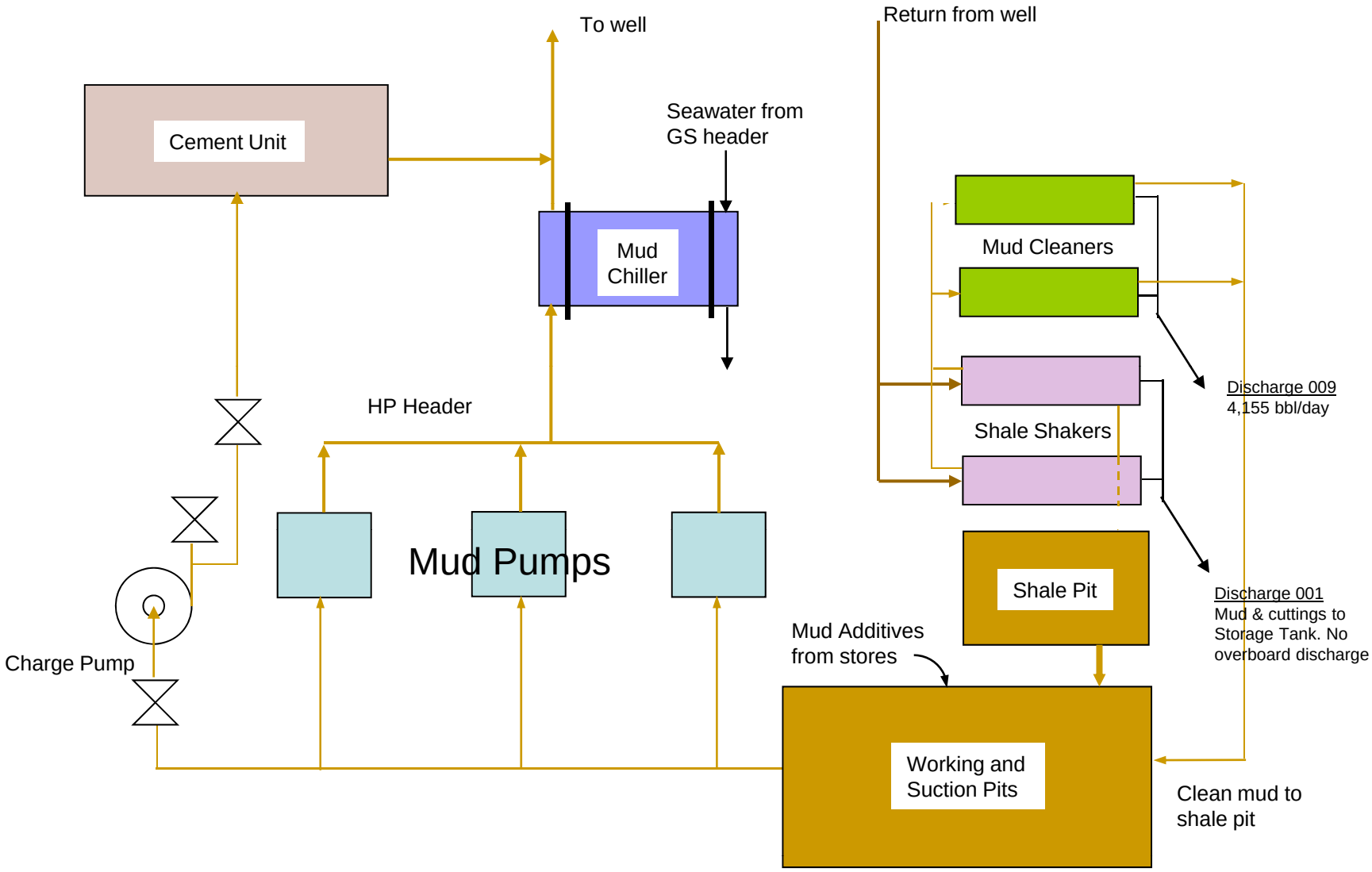
Type of Waste	Total Amount to be Discharged*	Discharge Rate*	Discharge Method
Drill cuttings – Discharge 013	4,031 bbl/well (Cuttings only; no drilling muds used)	697 bbl/day (discharged over 5 days)	Mud Line Cellar (MLC) Cuttings Deposited at the seafloor
Water based mud – Discharge 001	0 bbl/well	0 bbl/day	**No discharge**. Water based muds will be collected and transported out of the Arctic Ocean and disposed of in accordance with all applicable laws and regulations.
Drill cuttings from water base drilling fluid interval – Discharge 001	0bbl/well	0 bbl/day	**No discharge**. Cuttings from the water based drilling fluid interval will be collected and transported out of the Arctic Ocean and disposed of in accordance with all applicable laws and regulations.
Excess cement – Discharge 012	50 bbl/well	two occasions at 1 bbl/min	Discharged at seafloor during 30-inch and 20-inch cementing operations
Non-contact cooling water – Discharge 009	1,530,000 bbl/well	45,000 bbl/day	Discharged to the water at several sites
Sanitary waste – Discharge 003	0 bbl/well	0 bbl/day	**No discharge**. Treated in the MSD and stored on drillship then transported out of the Arctic Ocean and disposed of in accordance with all applicable laws and regulations.
Domestic waste – Discharge 004	0 bbl/well	0 bbl/day	**No discharge**. Gray water stored on drillship then transported out of the Arctic Ocean and disposed of in accordance with all applicable laws and regulations. Food wastes will not be discharged, they will be incinerated onboard
Desalination unit brine water – Discharge 005	4,250 bbl/well	125 bbl/day	Discharged through disposal caisson below water's surface
Deck drainage – Discharge 002	170 bbl/well	5 bbl/day (dependent on rainfall)	Discharged through disposal caisson below water's surface
Uncontaminated Ballast water – Discharge 010	0 bbl/well	0 bbl/day	**No Discharge**. Ballast water is stored on drillship then transported out of the Arctic Ocean and disposed of in accordance with all applicable laws and regulations.
Firewater bypass – Discharge 008	0 bbl	0 bbl/day	No routine firewater system testing anticipated
Bilge water – Discharge 011	0 bbl/well	0 bbl/day	**No discharge**. Treated in an oil/water separator; uncontaminated water and separated oily water is stored onboard then transported out of the Arctic Ocean and disposed of in accordance with all applicable laws and regulations.
BOP fluid – Discharge 006	42 bbl/well	Up to 6 BOP tests at an average 7 bbl/test	Discharged at the seafloor at the BOP

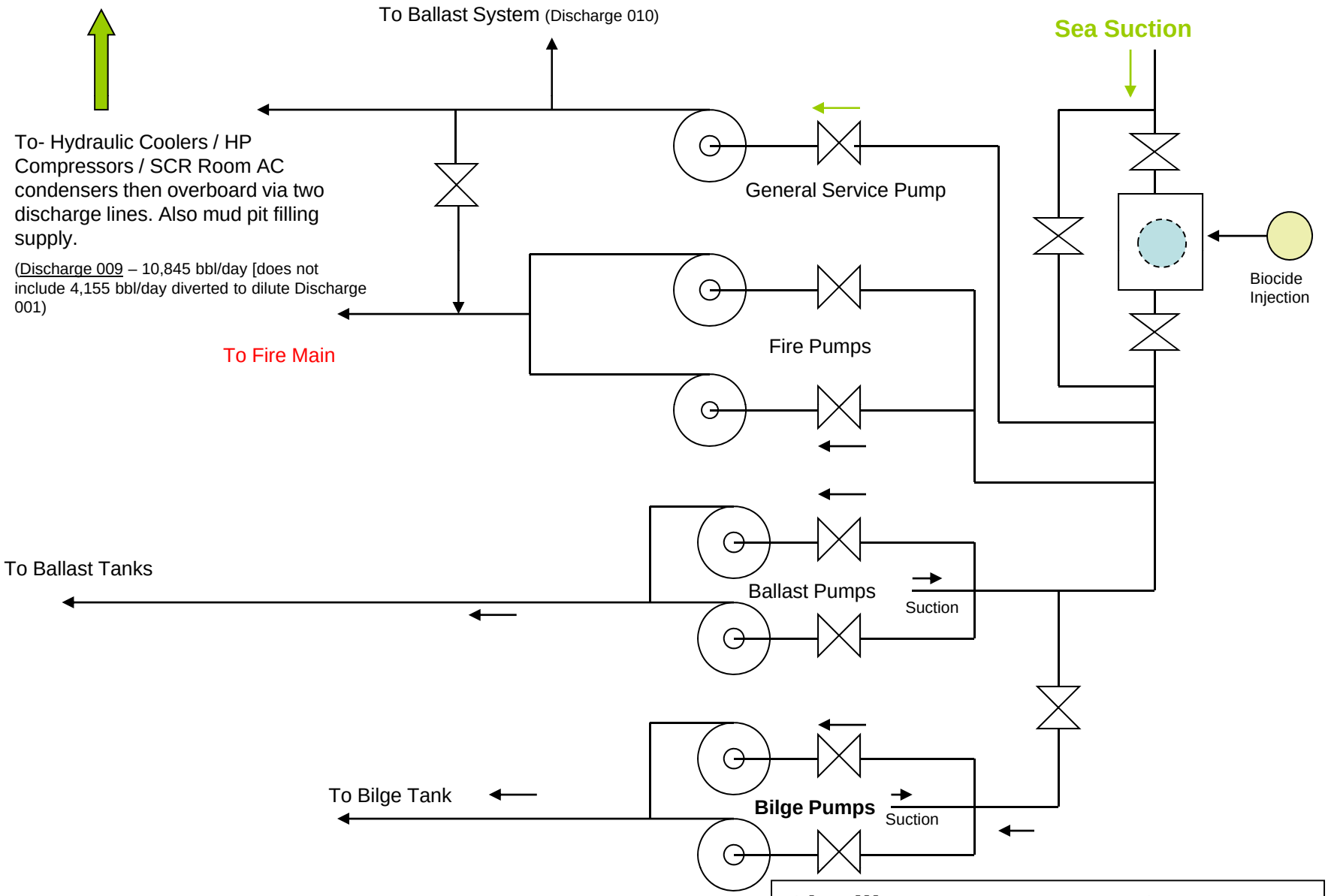
Notes:
* assumes 5 days to complete the MLC through 20" section; 29 days to complete the remainder of the well

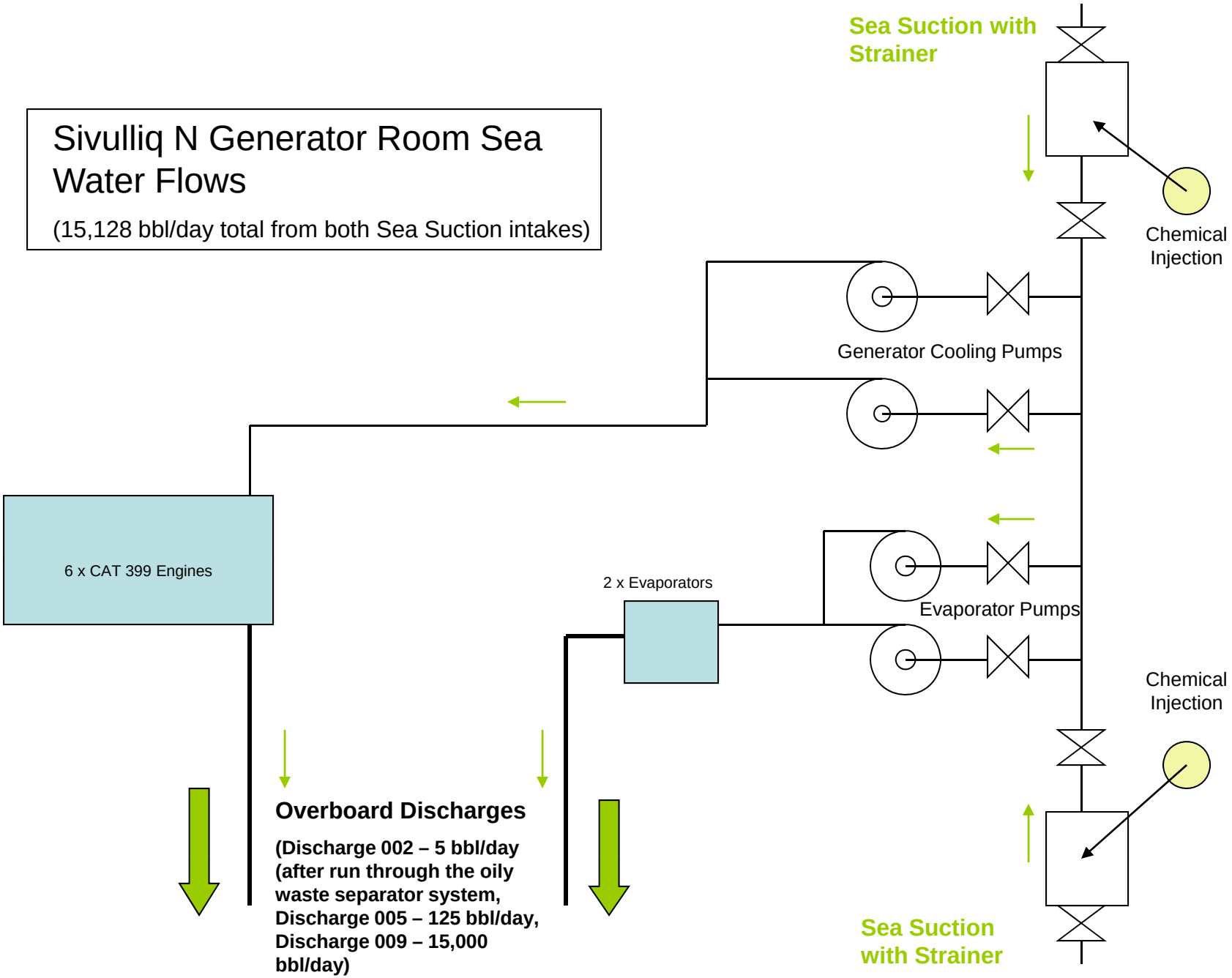
Discharge Flow Diagrams

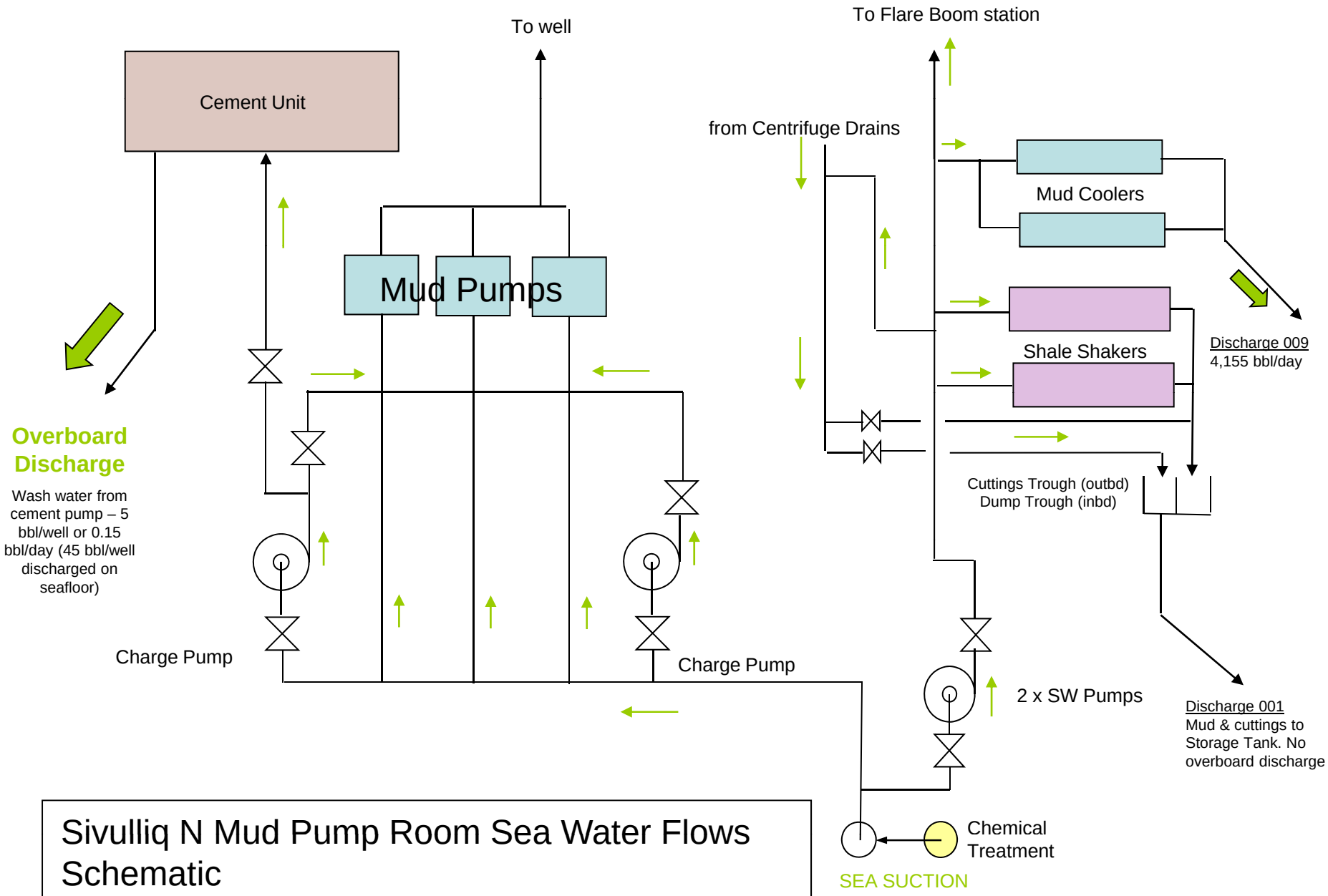

Overboard Discharges
(Discharge 009)
3 x ME Coolers
High Suction
Low Suction
Emergency
Bilge
Chemical Injection
ME Sea Water Pump
Main Engine
GS Pump
Refrigeration
Condenser
To Fire Main
Fire Pump
To Refrig.
Condensers
From Refrig.
Condensers
Helideck
Fire Pump
Sivulliq N Main Engine Room Non-Contact Cooling Water Flows
(15,000 bbl/day total)
Overboard Discharges
(Discharge 009 – 15,000 bbl/day from multiple outlets)

Sivulliq N Drilling Fluid Flowpath




To Ballast System (Discharge 010)
Sea Suction
To- Hydraulic Coolers / HP Compressors / SCR Room AC condensers then overboard via two discharge lines. Also mud pit filling supply.
(Discharge 009 – 10,845 bbl/day [does not include 4,155 bbl/day diverted to dilute Discharge 001)
General Service Pump
Biocide Injection
To Fire Main
Fire Pumps
To Ballast Tanks
Ballast Pumps
Suction
To Bilge Tank
Bilge Pumps
Suction
Sivulliq N Pump Room Sea Water Flows (Maximum 10,845 bbl/day)


Sivulliq N Generator Room Sea Water Flows
(15,128 bbl/day total from both Sea Suction intakes)
Sea Suction with Strainer
Chemical Injection
Generator Cooling Pumps
6 x CAT 399 Engines
2 x Evaporators
Evaporator Pumps
Chemical Injection
Overboard Discharges
(Discharge 002 – 5 bbl/day (after run through the oily waste separator system, Discharge 005 – 125 bbl/day, Discharge 009 – 15,000 bbl/day)
Sea Suction with Strainer

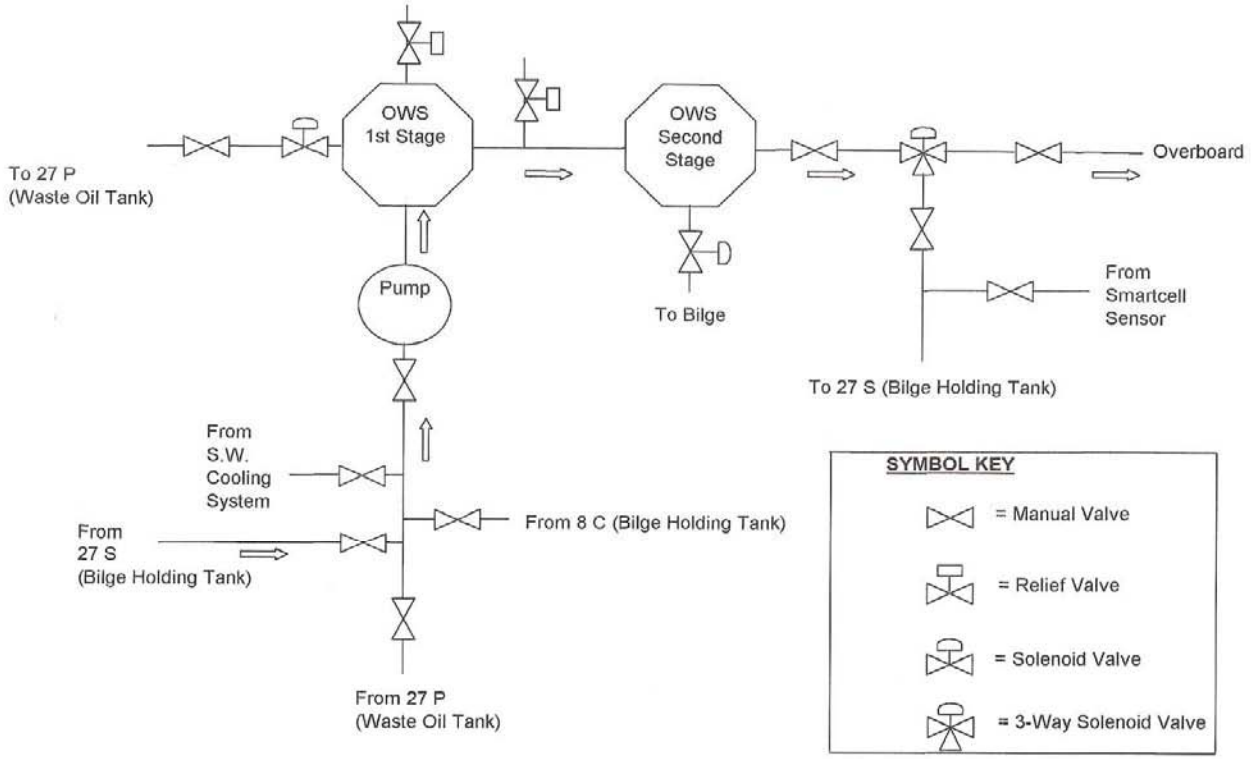


Sivulliq N Mud Pump Room Sea Water Flows Schematic

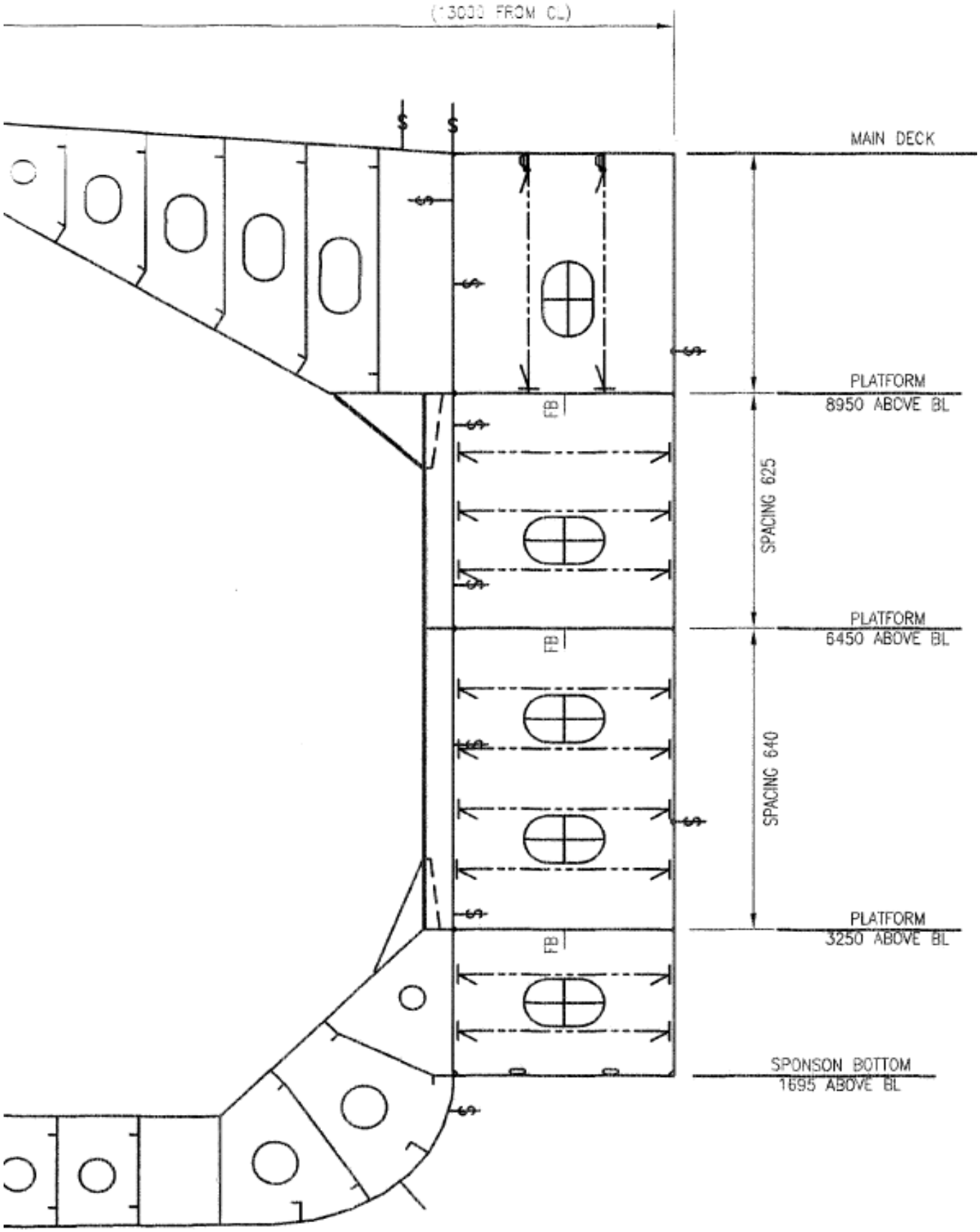
Maximum 4,155 bbl/day

Oily Water Separator System

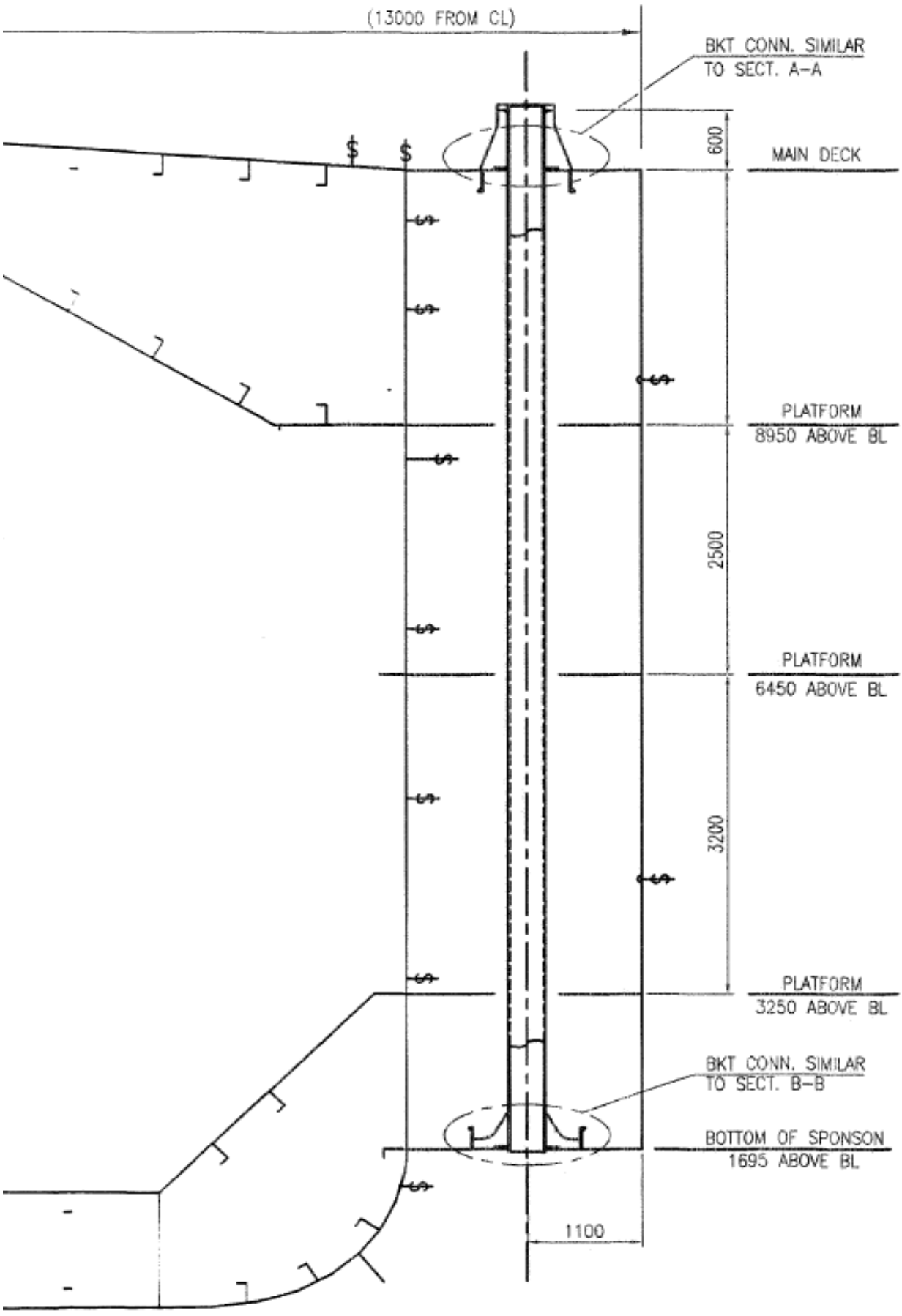
Oily Water Separator System



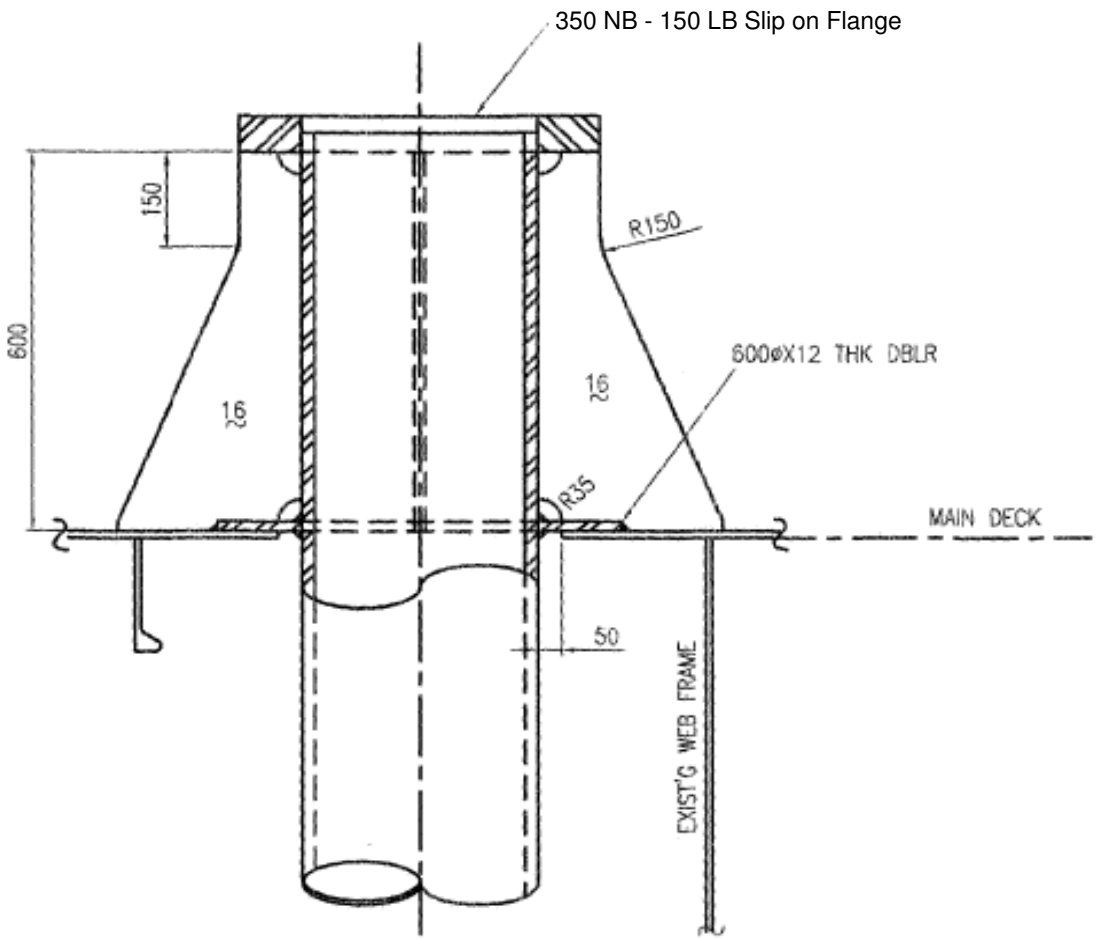
Discharge Caisson



SECTION AT FR 92



SECTION AT C.L. OF PIPE



SECTION A-A

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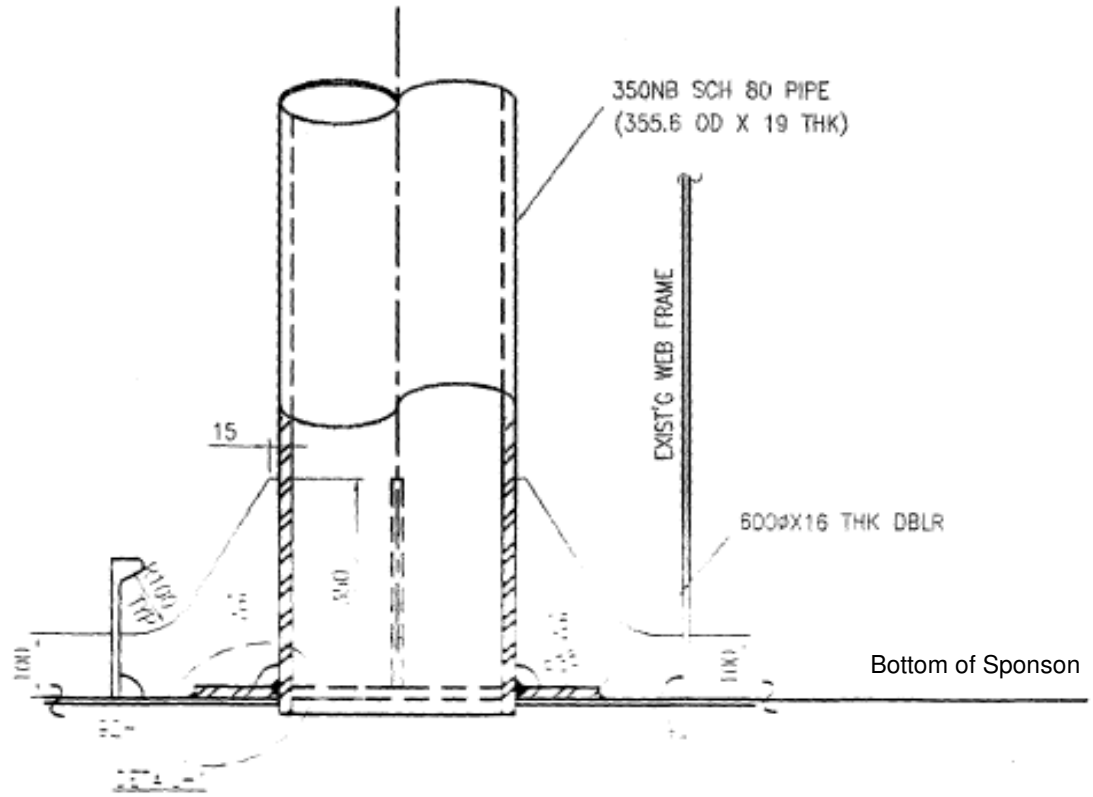


Discharge Caisson

The discharge caisson is a pipe that runs vertically through the sponson on the hull of the drillship from the main deck level to the base of the sponson. The sponson is an exterior reinforced cladding installed on the *Discoverer* to provide ice resistance. It is hollow and extends from the main deck level to well below the water line.

Waste streams are collected aboard the drillship to a point on the main deck near the mud room. A 15-in. diameter pipe exits the hull, turns downwards and is connected to the top of the discharge caisson.

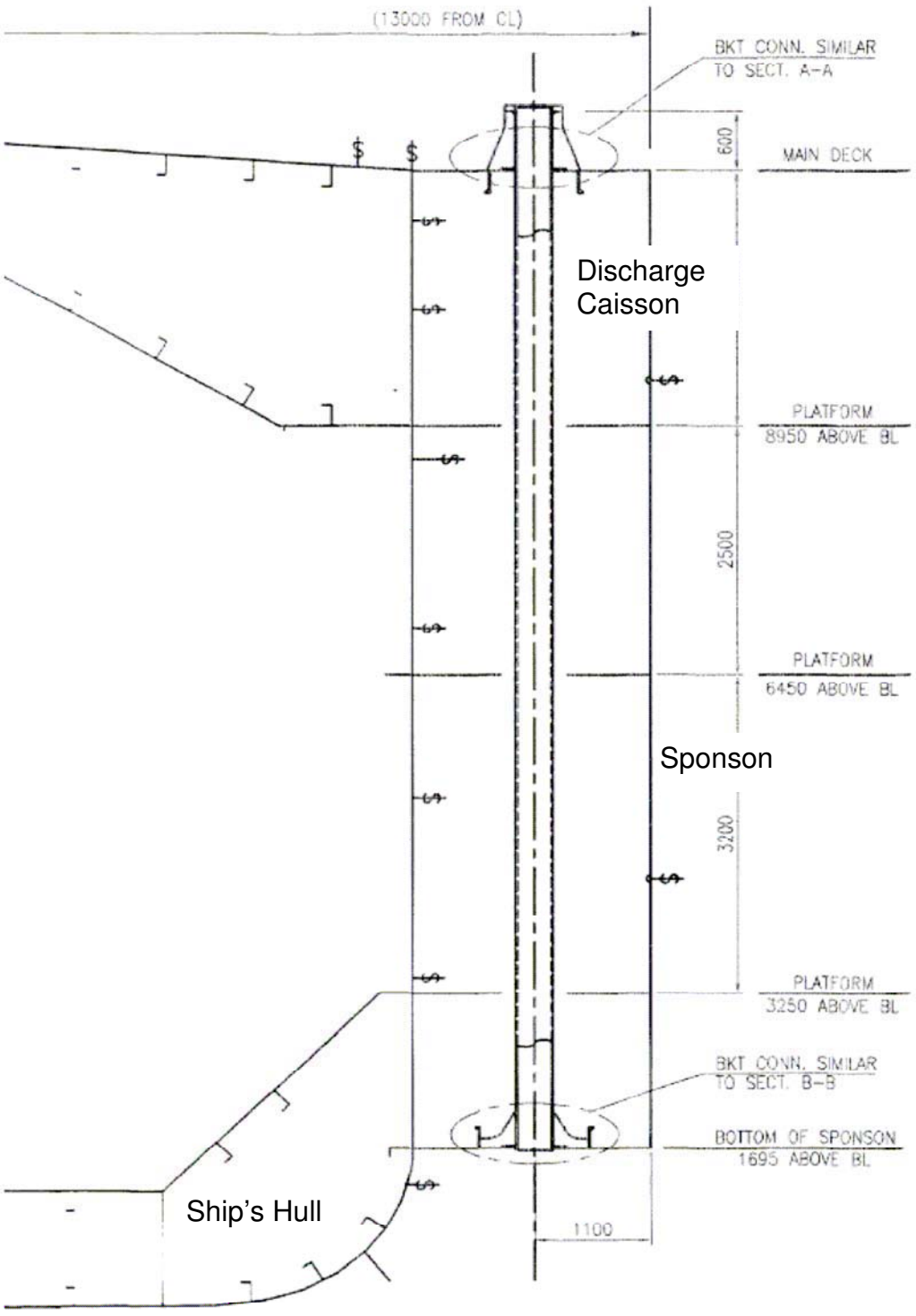
The discharge caisson, also a 15-in OD pipe, is welded into the sponson top and bottom (so that the interior of the sponson remains dry). The bottom of the sponson and the end of the discharge caisson is 5.6 ft (1.7 m) above the keel depth, and since it remains open to the sea at all times, the discharge caisson is constantly filled with water to mean sea level. This caisson is not equipped with a "float" valve; it is merely an open conduit to the sea through which most waste streams are discharged below sea level.

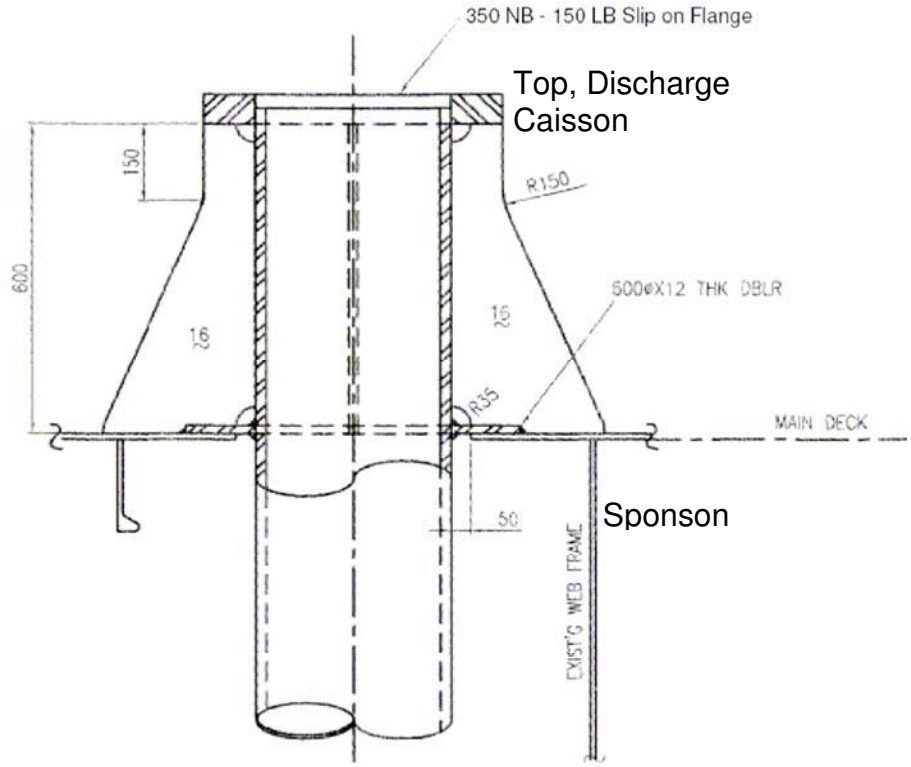
The *Discoverer* has the following draft characteristics:

Max draft at load line:	27 ft (8.2 m)
Transit draft	26.3 ft (8.0 m)
Drilling draft	25.2 ft (7.7 m)
Light ship draft	19.0 ft (5.8 m)

With the bottom of the sponson 5.6 ft above the keel, the base of the discharge caisson while drilling is 25.2 ft – 5.6 ft = 19.6 ft (6.0 m) below mean sea level. Because of heave, the water level inside the caisson is constantly changing.

See attached schematic drawings:


(13000 FROM CL)
BKT CONN. SIMILAR
TO SECT. A-A
600
MAIN DECK
Discharge
Caisson
PLATFORM
8950 ABOVE BL
2500
PLATFORM
6450 ABOVE BL
Sponson
3200
PLATFORM
3250 ABOVE BL
BKT CONN. SIMILAR
TO SECT. B-B
BOTTOM OF SPONSON
1695 ABOVE BL
Ship's Hull
1100



Top, Discharge Caisson

Sponson

SECTION A-A

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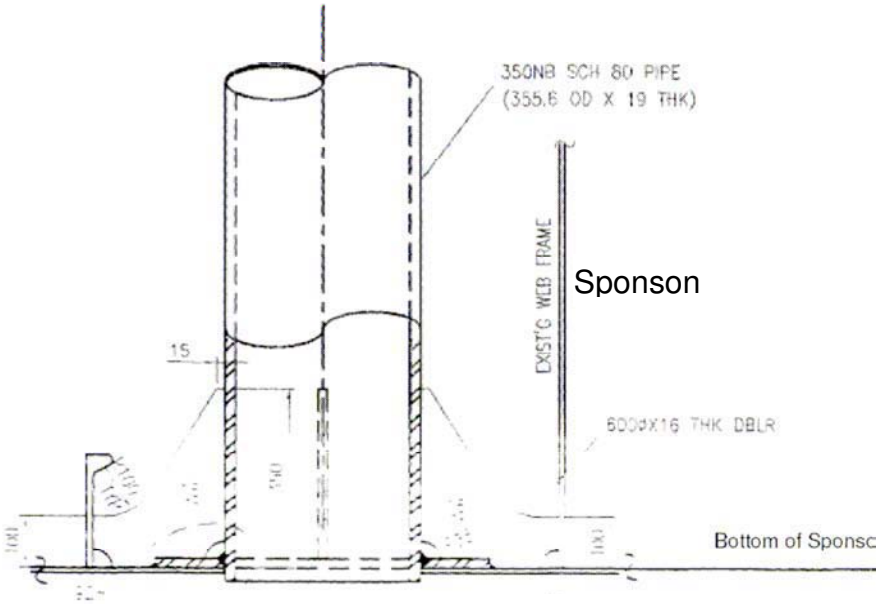


Sponson

Base, Discharge Caisson

IFE DRILLING / COMPLETION FLUIDS PROPOSAL

SHELL EXPLORATION & PRODUCTION CO.
SIVULLIQ N PROSPECT

Frontier Discoverer

Name	Signature	Date
Originator: Jim Dwyer		**August 12, 2010**
Reviewed by:		
Version: 1.0 Draft		

Well Summary

This program is planned for the Sivulliq N Prospect well for Shell to be drilled in the 2011 drilling season.

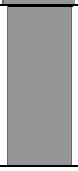
The Mud Line Cellar (MLC) will be drilled to @194' RKB using seawater only as a drilling fluid. The 30" casing interval is to be drilled in two stages using a 8-1/2" pilot bit and opened to 36" with a hole opener to a MD @317'. This interval will be drilled with seawater and periodic high viscosity sweeps as needed. The 20" casing interval will be drilled with seawater and periodic high viscosity sweeps as needed using a 8-1/2" pilot bit and opened to 26" with a hole opener run. The 12 ¼" intermediate hole will be drilled to the 9 5/8" casing point at 2,700' with 10 ppg PHPA/seawater/salt enhanced system. The 8-1/2" open hole will be drilled to a final TD @7,000' RKB. Mud weight estimates for this interval are 10.2 – 10.6 ppg, and again the mud system is PHPA/seawater/salt enhanced. This well is planned to TD @7,000' and could be tested prior to P&A operations.

IFE Benchmark and Goals

IFE Benchmarks
No Stuck Pipe
No Mud Related HSE Issues
Casing Strings to Bottom
No Accidents—No Spills

Shell Exploration & Production Co.
Sivulliq N Prospect

Casing and Project Summary

Casing Size (in)	Hole Size (in)	Profile	Measured Depth (ft)	Mud Type	Footage Drilled	Estimated Waste Volume Generated Cuttings / Mud	Mud Density Range (ppg)
Riser			194'	NA	NA	NA	NA
30"	36" 1.26 bbls/ft		317'	Seawater with sweeps	123'	155 Bbls (cuttings) 310 Bbls (Mud)	8.6
20"	26" .6567 bbls/ft		1,010'	Seawater with sweeps	693'	453 Bbls (cuttings) 906 Bbls (mud)	8.6
9 5/8"	12 1/4" .1458 bbls/ft		2,700'	NaCL / PHPA	1,690'	246 Bbls (cuttings) 320 Bbls (mud)	10.0
OH	8 1/2" .0702 bbls/ft	OH	7,000'	NaCL / PHPA	4,300	302 Bbls (cuttings) 393 Bbls (mud)	10.2 – 10.6

Note: Cuttings volume is gauge hole calculation

Water depth 107' to Mud Line
Bottom of Mud Line Cellar 194'

36" / 26" (8 ½" pilot) Intervals	
Drilling Fluid System	Seawater with sweeps
Key Products	Duovis, MI Wate, Caustic Soda, Soda Ash
Potential Problems	Large gravel sizes can cause hole-cleaning problems **Hydrates may be encountered** Wash out in unconsolidated sections
Interval Objectives	Provide adequate velocity to clean the hole of drill cuttings Minimize time in hole section Good cement jobs

SURFACE INTERVAL MUD PROPERTIES

Depth (ft)	Mud Wt. (lb/gal)	Funnel Vis (sec/qt)	Plastic Viscosity	Yield Point ($lb/100ft^2$)	API Fluid Loss (ml/30min)	Chlorides (mg/l)	pH
153 – 317 Riserless	Seawater w/ sweeps	N/A	N/A	N/A	N/C	seawater	N/A
317 – 1,010	Seawater w/ sweeps	N/A	N/A	N/A	N/C	seawater	N/A
KILL FLUID	11.5	50 – 60	10 – 15	15 – 30	N/C	@17,500	9.0 – 9.5

Kill Weight Fluid Formulation:

Base Water: Use seawater (chlorides estimated @17,000 mg/l)
Duovis: 2 – 3 PPB
Poly Pac-R: 2.0 PPB
MI Bar: 162 PPB

Recommended Sweep Mud Formulation:

Base Water: Use seawater
Soda Ash: 0.25 PPB
Duovis: 2 – 3 ppb
Caustic Soda: To provide pH @9.0 – 9.5
MI WATE: as needed

Surface (36" O.H.) Interval Discussion:

- Prior to spudding operations, it is suggested that 600 bbls of Kill Mud be prepared with an initial mud weight of 11.5 ppg. This system can be mixed with seawater using 2 – 3 ppb Duovis for suspension of barite. This fluid could be used later in the drilling operations for sweeps if not needed to kill the well.

- Mix 600 – 1,200 bbls of viscosified seawater for use in sweeps and for the preparation of drilling the 26" (8 ½" pilot hole) interval. This could remain unweighted until needed saving some materials. **The kill weight mud can be mixed with seawater prior to arriving on location. All possible pits should be topped off prior to arrival.**

- The 36" interval is planned to be drilled with a 8-1/2" bit, followed by a 36" hole opener run, using seawater with possible viscous or weighted sweeps as needed to assure hole cleaning.

- Sweep the pilot hole with 20 – 40 bbl sweeps as required by hole conditions. Spot a high viscosity, or weighted pill at TD to assure hole remains open during hole opening operations.

- Open the hole to 36" using seawater as the primary fluid. Sweep the hole periodically with 20 – 40 bbls of high viscosity fluid, and spot a high viscosity, or weighted, pill at TD for hole stability for the casing run.

Surface (26" O.H.) Interval Discussion:

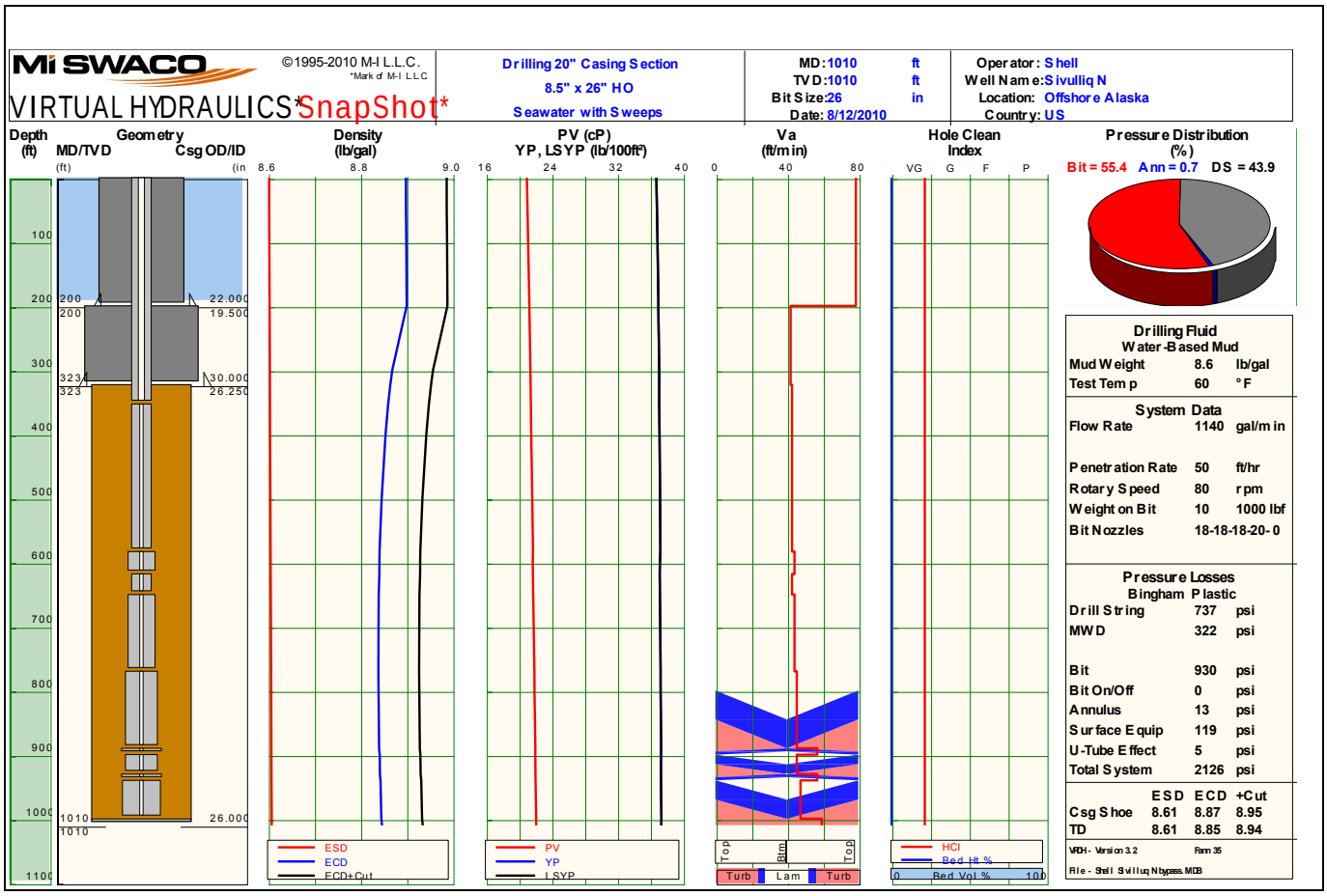
- Begin drilling this interval (8.5" pilot hole) with seawater and have pit of prehydrated Duovis available for pumping sweeps.

- Maintain pit of viscosified (Duovis) seawater throughout this interval for pumping sweeps.

- Upon reaching TD with the 8-1/2" pilot bit, spot high viscosity mud in the open hole to assure wellbore stability while out of the hole.

- Underream the hole to 26", use 11.5 ppg kill mud for sweeps and spotting in open hole at casing point.

Virtual Hydraulics 26” Hole Model:



12-1/4" Interval	
Drilling Fluid System	Seawater / PHPA / Salt Enhanced Mud System
Key Products	MI Wate, Soda Ash, Duo-Vis, Poly Pac UL, Caustic Soda, SP-101, Poly Plus RD, Tackle, Citric Acid, Sodium Bicarbonate, Biocide, Salt (10%)
Potential Problems	Tight hole conditions Hole enlargement / bit balling Bacterial problems Coal seams / sloughing Pressured shales / sloughing shales Lost circulation
Interval Objectives	Maintain fluid rheological properties to provide proper hole cleaning Minimize time spent in hole interval Reduce shaker blinding from polymer additions Condition mud for running and cementing casing string

Interval Fluid Properties

Depth (ft)	Mud Wt. (lb/gal)	Funnel Vis. (sec/qt)	PV (cp)	Yield Point ($lb/100ft^2$)	API Fluid Loss (ml/30min)	HTHP @ BHCT Fluid Loss (ml/30min)	pH	Drill Solids (%)	MBT
1,010 –2,700	10.0	45 – 60	10 – 20	20 – 35	< 6.0	<8.0	9.0 – 9.5	< 5	<15.0

Interval Fluid Formulation (for new fluid):

Base Water:	Use seawater (chlorides estimated @17,500 mg/l)
Soda Ash:	0.25 – 0.5 PPG (pilot test to determine concentration needed)
Poly Plus RD:	1.0 – 1.75 PPB
Duo-Vis:	1.0 PPB
Poly Pac UL:	1.0 PPB
SP-101:	1.0 PPB
Caustic Soda:	For a steady pH of 9.0 – 9.5
Barite:	As needed for desired mud weight
Salt	10% v / v

Recommended Mixing Procedures:

- Premix the Poly Plus (PHPA) system in 10% brine as follows:

1. Reduce the total hardness in the seawater with Caustic Soda and Soda Ash
2. Add Biocide for bacterial control
3. Add the Duo-Vis (1.0 PPB)
4. Circulate with a homogenizer pump to achieve maximum viscosity and shear
5. Add MI Wate to adjust the weight to 10.0 PPG (@90 PPB)
6. Add Poly Plus RD through the Lobe-Star hopper system (1.0 PPB initial concentration)
7. Add Poly Pac UL (1.0 PPB) to the system to adjust the fluid loss values

- Control the density with MI WATE, seawater additions, salt, and solids control equipment; dump sand traps as required. Monitor and dump the ~~-g~~umbo box" every 45 – 90' drilled to reduce solids buildup.

- Increase the concentration of Poly Plus RD up to 1.75 PPB through the additions of premixed fluid as required—assure the product has been adequately sheared to prevent screen blinding problems with the shale shakers. **Do not be in a hurry increasing the concentration—let the hole and shaker conditions dictate.**

- Control the pH and total hardness with additions of Soda Ash, Sodium Bicarbonate and Citric Acid.

- Use Defoam X should foaming become a problem. Maintain an adequate concentration of Biocide in the system to prevent bacterial problems from developing.

- Isolate a small pit of the previous mud system to drill the float collar, cement and casing shoe. Treat this fluid as required to prevent excessive cement contamination. Using the PHPA mud system to drill cement will require treatment with Citric Acid and/or Sodium Bicarbonate (if using both at the same time, pilot testing is suggested). Keeping the bulk of the used system isolated will prevent having to replace a large volume of fluid should the contamination become excessive.

- Control the mud density with additions of MI WATE, seawater, salt, and use of rig solids control equipment; dump sand traps as necessary.
- Increase and maintain the concentration of Poly Plus RD to 1.75 PPB through the additions of premixed fluid as required; assure the product has been adequately sheared to prevent screen blinding problems with the shale shakers. Depletion rate for Poly Plus RD is approximately 5 # / barrel of solids drilled.
- Control the hardness and pH with additions of Soda Ash, Sodium Bicarbonate and Citric Acid. Use Defoam X should foaming become a problem.
- Maintain an adequate concentration of Biocide in the system to prevent bacterial problems from developing.
- Use Poly Pac UL and SP-101 (up to 3 PPB is recommended) for fluid loss control (expect some rheological property changes should the product concentrations be increased). Should viscosities become excessive or hard to control, the use of Tackle, CF Desco, Tannathin, and/or Spersene CF is recommended (pilot test). Should the HTHP values become hard to attain, the use of Resinex is recommended.
- Drill to the interval TD, and short trip to check for fill and hole conditions. Log / test as desired. Run 7" liner if needed or desired.

Potential Problems:

- Tight hole conditions: Reduce the fluid loss; increase the concentration of Poly Plus RD; increase the mud weight.
- Hole enlargement / bit balling: Increase the viscosity; increase the concentration of Poly Plus RD; treat with additions of SAPP or Desco CF.
- Bacterial problems: Increase and maintain an adequate concentration of Biocide in the system. Bacteria are present in the seawater and will need to be treated immediately upon addition to the mud system to prevent growth.
- Coal seams: May be present; good drilling practices are essential to prevent hole problems, stuck pipe, and hole enlargement if encountered.
- Pressured / sloughing shales: Anticipate any pressured shales based on log or seismic results; try to have the mud system weighted up adequately before entering these areas; reduce the HTHP fluid loss; add Resinex (in advance of any anticipated problem areas).
- Lost circulation: Good drilling practices; slow the pumps to reduce the ECD; add LCM; maintain an ade-

quate supply of lost circulation materials on location.

- High solids: Whole mud additions are recommended if the MBT exceeds 15 PPB; maintain drilled solids as low as possible with aggressive use of solids control equipment and water.

PHPA System Notes:

- MBT (bentonite equivalent) values should range between 0 and 15, not exceeding 17, in the upper intervals and 10 or less in the lower (8 1/2" open hole) interval to prevent overloading with solids and reducing the capability of the Poly Plus RD for encapsulating and stabilizing the solids and formations drilled.

- Run the HTHP and API fluid loss tests twice daily to watch for changes indicating adverse affects on the test by formations drilled, lack of control chemicals, and thermal degradation of the products.

- Attempt to run the system as non-dispersed as possible controlling the fluid loss with Poly Pac, SP-101, and Resinex additions. Should gel strengths become excessive or the system is overloaded with solids, light treatments with Tannathin or the polymeric thinner Tackle is recommended.

- Should mud weights exceed 12 PPG, consideration should be given to lightly disperse the system and discontinue or reduce the additions of PHPA. Mud weights in excess of 13 PPG will require thinners.

- Yield points and gel strengths will be higher in this type system than in most other water-based mud systems. This is not detrimental, since these high gel strengths are fragile and the fluid is shear thinning. The 3 RPM reading or zero gel strength is a good indicator of the viscoelasticity of the system. By maintaining adequate 3 RPM readings, solids suspension will be improved and hole erosion can be minimized. The 3 RPM reading can be adjusted with additions of Duo-Vis.

- Whenever possible a premix of a higher density PHPA mud should be kept available for weight-ups. The PHPA concentration should be equal to or slightly higher than that of the active system. Barite additions can be accomplished faster and with less disrupting to the existing equilibrium when the added barite has been pre-wet via the premix process.

- PHPA depletes from the active system while drilling at a rate of @5 # / barrel of solids drilled, so constant replenishment is required. There must be an excess of PHPA in the mud to stabilize the rheology properties particularly with drilling reactive clays which will deplete PHPA quickly and cause increases in viscosities.

Seawater / PHPA Displacement Recommendations:

- Clean the rig pits and flush all surface lines prior to preparing the PHPA mud system. Isolate a small pit of surface spud mud to drill out the 20" casing collar, cement and shoe.

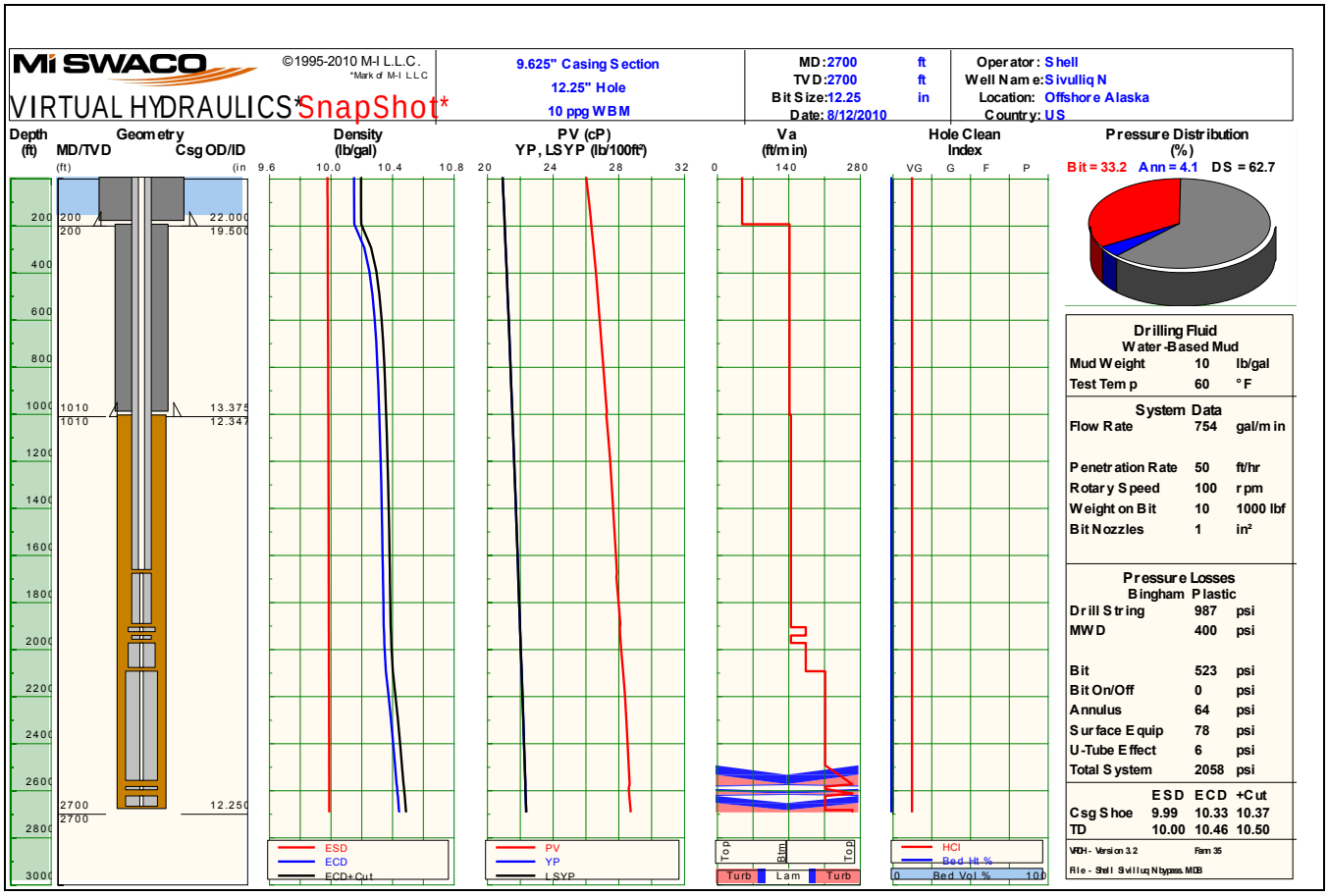
- Mix up a 50-60 bbl high viscosity spacer in the pill pit using 3.0 ppb DUO-VIS and seawater. If the pill pit is being used the spacer may be left out.

- After drilling the shoe track and prior to drilling the float shoe, displace out the spud mud to the PHPA system while pumping the high viscosity sweep ahead.

- Pump the 10.0 PPG PHPA salt-enhanced mud system at a high rate while rotating the drill pipe to ensure minimal interface and a good displacement.

- Drill to the interval TD, short trip to check for fill and hole conditions, and run and cement the 9-5/8" casing string.

Virtual Hydraulics 12.25” Hole Model:



8 1/2" Production Interval	
Drilling Fluid System	Seawater / PHPA Mud System
Key Products	MI Wate, Soda Ash, Duo-Vis, Poly Pac UL, Caustic Soda, SP-101, Poly Plus RD, Tackle, Citric Acid, Sodium Bicarbonate, Biocide
Potential Problems	Tight hole conditions Hole enlargement / bit balling Bacterial problems Coal seams / sloughing Pressured shales / sloughing shales Lost circulation
Interval Objectives	Maintain fluid rheological properties to provide proper hole cleaning Minimize time spent in hole interval Reduce shaker blinding from polymer additions Condition mud for running logs

Intermediate Interval Fluid Properties

Depth (ft)	Mud Wt. (lb/gal)	Funnel Vis. (sec/qt)	PV (cp)	Yield Point lb/100ft^2	API Fluid Loss (ml/30min)	HTHP @ BHCT Fluid Loss (ml/30min)	pH	Drill Solids (%)	MBT
2,700 - 7,000	10.2 -10.6	48 – 62	12 – 20	20 – 35	< 4.0	<8.0	9.0 –9.5	< 5	<10.0

Production Interval Fluid Formulation (for new fluid):

Base Water:	Use seawater (chlorides estimated @17,500 mg/l)
Soda Ash:	0.25 – 0.5 PPG (pilot test to determine optimum concentration)
Poly Plus RD:	1.0 – 1.75 PPB
Duo-Vis:	1.0 PPB
Poly Pac UL:	1.0 – 1.5 PPB
SP-101:	1.0 – 2.0 PPB
Caustic Soda:	For a steady pH of 9.0 – 9.5
Biocide:	As needed for bacterial control
Barite:	As needed for mud weight

- Isolate a small pit of the previous mud system to drill the 9-5/8" collar, cement and casing shoe. Treat this fluid as required to prevent excessive cement contamination. Using the PHPA mud system to drill cement will require treatment with Citric Acid and/or Sodium Bicarbonate (if using both at the same time, pilot testing is recommended). Keeping the bulk of the used system isolated will prevent having to replace a large volume of fluid should the contamination become excessive.

- Following the cement job and assorted work involved, aggressively treat the remaining mud system on surface with the solids removal equipment and additions of premixed PHPA fluid to optimize fluid properties. Solids need to be reduced at every opportunity, so centrifuging from one pit to the next would be beneficial. Dump and clean sand traps and any settling pits.

- Control the mud density with additions of MI Wate, seawater, and the use of rig solids control equipment.

- Increase and maintain the concentration of Poly Plus RD to >1.75 PPB through the additions of premixed fluids as required; assure the product has been adequately sheared to prevent screen blinding problems with the shale shakers.

- Control the hardness and pH with additions of Soda Ash, Sodium Bicarbonate and Citric Acid. Use Defoam X should foaming become a problem.

- Maintain an adequate concentration of Biocide in the system to prevent bacterial problems from developing.

- Use Poly Pac UL and SP-101 (up to 4 PPB is recommended) for fluid loss control (expect some rheological property changes should the product concentrations be increased. Should viscosities become excessive or hard to control, the use of Tackle, Desco CF, and/or Tannathin is recommended (pilot test). Should the HTHP values become hard to attain, the use of Resinex is recommended.

- Drill to the interval TD, short trip to check for fill and hole conditions, and log if desired.

Potential Problems:

- Tight hole conditions: Reduce the fluid loss; assure the concentration of Poly Plus RD is at least 1.75 PPB in the system; increase the mud weight gradually. Intervals drilled with a PHPA system are generally more ~~-in~~ gauge" than those drilled with other systems, so be prepared to do some back reaming on the initial trip out. Wiper trips at least every 1,000' drilled are strongly recommended.

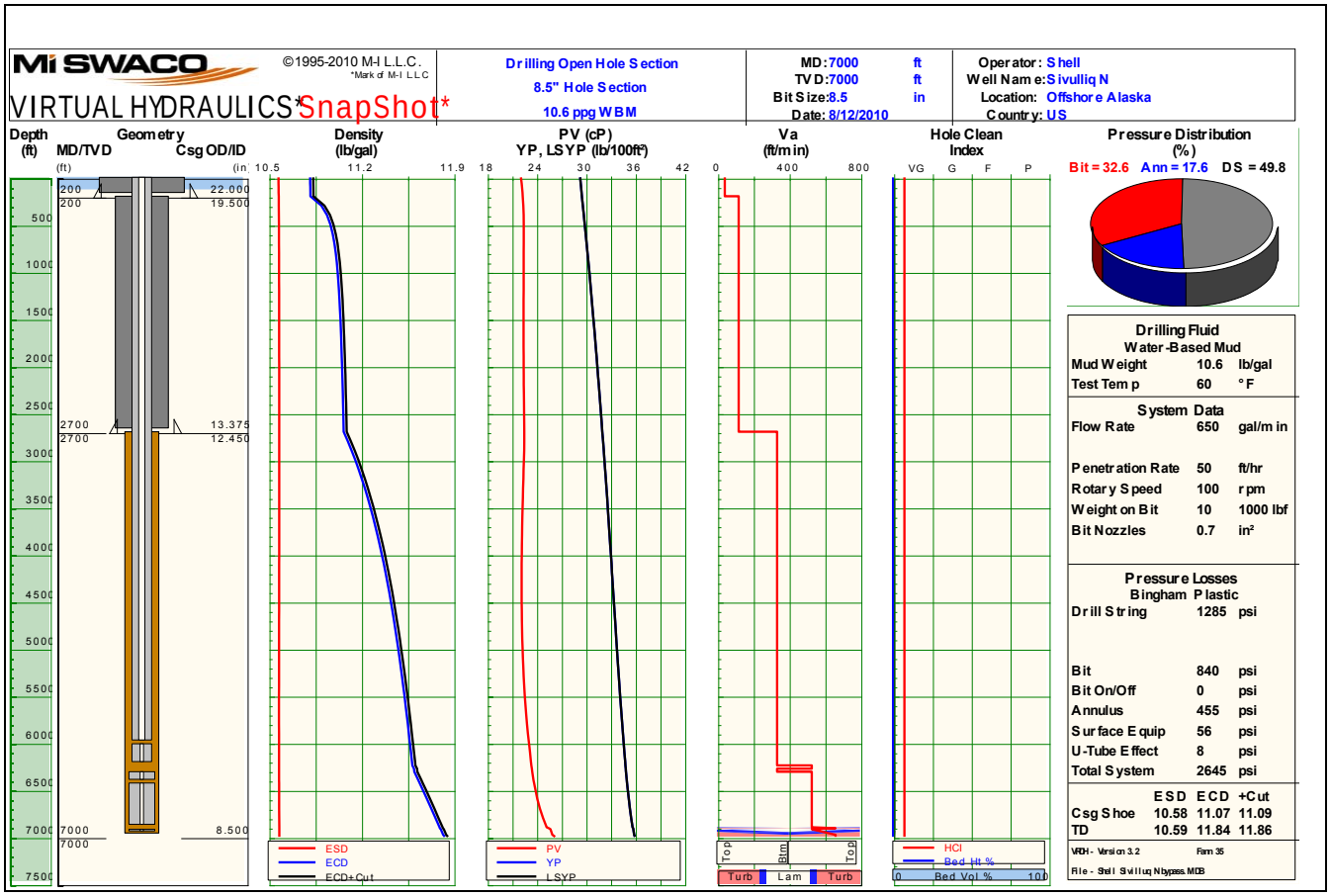
- Bacterial problems: Increase and maintain an adequate concentration of Biocide in the system. Bacteria are present in the seawater and will need to be treated immediately prior to any water additions to the mud system to prevent growth. All batch-mixed fluid needs to be aggressively treated prior to the addition of polymers—kill the bacteria prior to adding.

- Pressured / sloughing shales: Anticipate any pressured shales based on log or seismic results; try to have the mud system weighted up adequately before entering any pressured areas; reduce fluid loss (in advance of any anticipated problem areas).

- Lost circulation: Good drilling practices; slow the pumps to reduce the ECD; add LCM; maintain an adequate supply of lost circulation materials on location. **Follow the Lost Circulation Decision Tree.**

- High solids: Whole mud dilutions are recommended if the MBT exceeds 10 PPB; maintain drilled solids as low as possible with aggressive use of solids control equipment and water.

Virtual Hydraulics 8.5” Hole Model:



SHELL EXPLORATION & PRODUCTION CO
ESTIMATED LOADOUT SIVULLIQ N
Water Based Mud Products

PRODUCT	UNIT SIZE	Pallets Space	TOTAL USAGE
MI BAR	50 # sack	Bulk	12,000
MI GEL	50 # sack	Bulk	1000
CAUSTIC SODA	50 # sack	3 pallets	150
SODA ASH	50 # sack	4 pallets	120
SOD. BICARB	50 # sack	4 pallets	120
DUO-VIS	50 # sack	8 pallets	320
POLY PLUS RD	50 # sack	12 pallets	480
TACKLE	50 # sack	2 pallets	100
POLY PAC R	50 # sack	1 pallets	40
POLY PAC UL	50 # sack	4 pallets	200
SP-101	50 # sack	3 pallets	120
CITRIC ACID	50 # sack	2 pallets	100
MYACIDE	5 GAL	4 pallets	200
CONTINGENCY:			
SALT	50 # sack	32 pallets	1,600
GELEX	1 # sack	1 pallet	50
DEFOAM X	5 GAL	3 pallets	45
NUT PLUG (ASST.)	50 # sack	4 pallets	200
MIX II (ASST.)	50 # sack	4 pallets	200
DESCO CF	50 # sack	3 pallets	144
SAPP	50 # sack	1 pallet	45
LIME	50 # sack	1 pallet	40
		100 pallets	
3000 bbls 9.8 BRINE			

Logistics / Resupply:

When resupply becomes an issue, it would be possible to do so out of Deadhorse via barge lift from the MI Mud Plant stock point as needed. Due to the unstable weather conditions in the arctic regions, all possible products should be brought out on the rig and dispersed throughout the escort fleet in case a resupply barge could not be used.

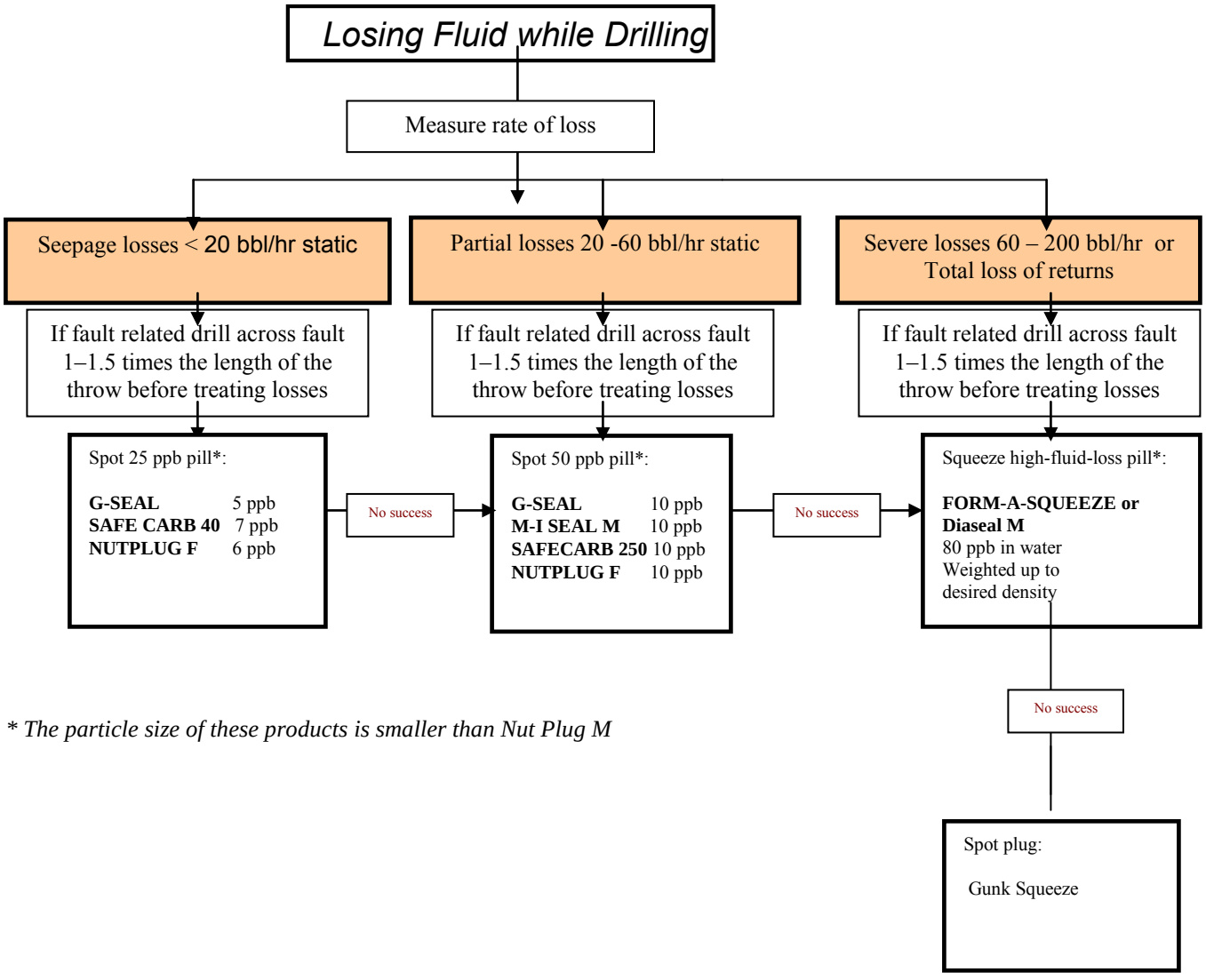
Coring Operations:

The drilling fluids as described should be sufficient for any coring operations desired. Lubricants are not to be used in the Beaufort Sea due to strict environmental rules, so the fluid should be kept as clean as possible via the use of solids removal equipment and through the use of new fluids as needed.

Lost Circulation Decision Tree

Although the risk for loss circulation is unknown, be certain to have an adequate amount of Lost Circulation Material (LCM) on location. Follow the LCM Decision Tree when encountering lost circulation. Be sure to cycle open the CCV (circulation sub, if present) when pumping a lost circulation pill containing coarse lost circulation material. Pump suction screens should also be removed prior to pumping to prevent plugging. Since solid casing strings and an open hole completion is being utilized, a wider choice of LCM types and sizes are available. Discuss the type and size of any LCM planned with the Shell Project Engineer and the MI Swaco Project Engineer before pumping.

WBM Lost Circulation Flowchart



** The particle size of these products is smaller than Nut Plug M*

HSE Issues

Handling of Drilling Fluid Products

Health and Safety

- Drilling crews should be instructed in the proper procedures for handling fluid products.
- Personal Protective Equipment (PPE) charts should be posted in the pit room, the mud lab, and the office of the Drilling Forman.
- PPE must be in good working order and be utilized as recommended by the PPE charts.
- Product additions should be made with the intent to use complete unit amounts of products (sacks, drums, cans), as much as possible in order to minimize inventory of partial units.
- Ensure all MSDS sheets are up to date and readily available for workers to access for information.

Environmental

- Ensure that all product stored outside is protected from the weather.
- Do not store partial units (sacks) outside if possible.
- When transferring fluids and/or cuttings from the rig to tanks, ensure all hoses are properly secured. Perform a transfer checklist as needed in order to avoid spills.

PPE Chart

Product	Function	Health	Flammability	Reactivity	PPE
CAUSTIC SODA	Alkalinity control	3	0	1	X
CITRIC ACID	pH Adjuster	1	0	0	E
DEFOAM X	Defoamer	1	1	0	J
DESCO CF	Dispersant	1	1	0	E
DUO-VIS	Viscosifier	1	1	0	E
G-SEAL	Graphite loss circulation	1	1	0	E
GELEX	Bentonite Extender	1	1	0	E
MI WATE (BARITE)	Weighting Agent	*1	1	0	E
MI GEL (BENTONITE)	Viscosifier	*1	1	0	E
MI SEAL F, M, C	Loss circulation material	*1	1	0	E
NUT PLUG	Loss circulation material	*1	1	0	E
POLY PAC UL	Viscosifier, Fluid Loss Control	*1	1	0	E
POLY PLUS RD	Shale encapsulation	1	1	0	E
SAFE CARB F, M, C	Bridging & weighting agent	*1	0	0	E
SALT (NACL) & Brine Solution	Densifier	1	0	0	E
SAPP	Dispersant	*1	0	0	E
SODA ASH	Calcium precipitation	1	1	0	E
SODIUM BICARB	Alkalinity control	1	0	0	E
SP-101	Fluid Loss Agent	1	1	0	E
SPERSENE CF	Dispersant	1	1	0	E
TACKLE	Polymeric Thinner	1	1	0	J
TANNATHIN	Lignite	*1	1	0	E
MYACIDE	Biocide	*2	0	0	J

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM
(HMIS) HAZARD RATINGS

4 - Severe hazard
3 - Serious hazard
2 - Moderate hazard
1 - Slight hazard
0 - Minimal hazard

- An asterisk next to the health rating indicates that a chronic hazard is associated with the material.

HMIS PERSONAL PROTECTIVE EQUIPMENT INDEX

A - Safety Glasses
B - Safety Glasses, Gloves
C - Safety Glasses, Gloves, Synthetic Apron
D - Face Shield, Gloves, Synthetic Apron
E - Safety Glasses, Gloves, Dust Respirator
F - Safety Glasses, Gloves, Synthetic Apron, Dust Respirator
G - Safety Glasses, Gloves, Vapor Respirator
H - Splash Goggles, Gloves, Synthetic Apron, Vapor Respirator
I - Safety Glasses, Gloves, Dust and Vapor Respirator
J - Splash Goggles, Gloves, Synthetic Apron, Dust and Vapor Respirator
K - Air Line Hood or Mask, Gloves, Full Suit, Boots
X - Consult your supervisor for special handling directions